

# Hydrologic Modeling

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Model Computations

# Hydrologic Modeling in NWSRFS

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Data Ingest

Data  
Pre-processing

Model  
Computations

Product  
Dissemination

# NWSRFS Operations

- ▶ 1 SAC-SMA Sacramento soil-moisture accounting model
- ▶ 2 UNIT-HG Unit hydrograph
- ▶ 3 REDO-UHG Reduced order unit hydrograph
- ▶ 4 CLEAR-TS Clear time series
- ▶ 5 SAC-PLOT Sacramento type daily flow plot
- ▶ 6 MEAN-Q Mean discharge computation
- ▶ 7 LAG/K Lag and K routing
- ▶ 8 CHANLOSS Simplified channel loss/gain
- ▶ 9 MUSKROUT Muskingum routing
- ▶ 10 ADD/SUB Add and subtract time series
- ▶ 11 LAY-COEF Layered coefficient routing
- ▶ 12 INSQPLOT Instantaneous discharge plot
- ▶ 13 TATUM Tatum routing
- ▶ 14 ADJUST-Q Flow adjustment and blend
- ▶ 15 WEIGH-TS Weight time series
- ▶ 16 STAT-QME Mean discharge statistics
- ▶ 17 WY-PLOT Water year daily flow plot
- ▶ 18 PLOT-TS General time series plot
- ▶ 19 SNOW-17 Hydro 17 snow model
- ▶ 20 CHANGE-T Change time interval
- ▶ 21 DWOPER Dynamic wave routing
- ▶ 22 SS\_SAC State-space Sacramento model
- ▶ 23 STAGE-Q Stage-discharge conversion
- ▶ 24 API-CONT Continuous API model
- ▶ 25 PLOT-TUL Tulsa operational plot
- ▶ 26 RES-SNGL Single reservoir simulation model
- ▶ 27 LIST-FTW Fort Worth tabular display
- ▶ 28 CHANLEAK Conceptual channel loss model
- ▶ 29 API-MKC Kansas City API rainfall-runoff model
- ▶ 30 MERGE-TS Merge time series
- ▶ 31 SNOW-43 State-space snow model
- ▶ 32 FFG Flash flood guidance
- ▶ 33 API-CIN Cincinnati API rainfall-runoff model
- ▶ 34 API-SLC Salt Lake City API rainfall-runoff model
- ▶ 35 API-HAR Harrisburg API rainfall-runoff model
- ▶ 36 XIN-SMA Xinanjiang soil-moisture accounting
- ▶ 37 LIST-MSP Minneapolis tabular runoff display
- ▶ 38 BASEFLOW Baseflow simulation
- ▶ 39 LOOKUP Table lookup (2-variable)
- ▶ 40 WATERBAL Water balance display
- ▶ 41 API-HAR2 Harrisburg API rainfall-runoff model #2
- ▶ 42 RSNWELEV Rain-snow elevation
- ▶ 43 API-HFD Northeast RFC API rainfall-runoff model
- ▶ 44 SARROUTE SSARR multi-phase routing
- ▶ 45 DELTA-TS Change in time series values
- ▶ 46 NOMSNG Generate no missing value time series
- ▶ 47 PEAKFLOW Comparison of peak flows
- ▶ 48 MULT/DIV Multiply and divide time series
- ▶ 49 BEGASSIM Begin assimilator loop
- ▶ 50 ASSIM Assimilator updating
- ▶ 51 SSARRESV SSARR reservoir regulation
- ▶ 52 SUMPOINT SSARR summing point
- ▶ 53 LOOKUP3 Table lookup (3-variable)
- ▶ 54 SWB-NILE Simple water balance model
- ▶ 55 FLDWAV Generalized Flood Wave Routing
- ▶ 56 GLACIER AKRFC Glacier model
- ▶ 57 CONS\_USE Consumptive Use model
- ▶ 58 RES-J Joint reservoir model
- ▶ 59 TIDEREV Tide balance review
- ▶ 60 ADJUST-T Tide adjustment
- ▶ 61 STAGEREV Review stage
- ▶ 62 ADJUST-H Stage adjustment



# Forecast Component Initialization

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FCINIT

# Forecast Component Initialization Program

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FCINIT is the file maintenance program for the Forecast Component.

- Define Segment information including the Operations Table and parameters for each Operation.
- Define rating curves
- Define computational order information for the Segments
- Redefine, delete and output this information.
- Status information

# FCINIT

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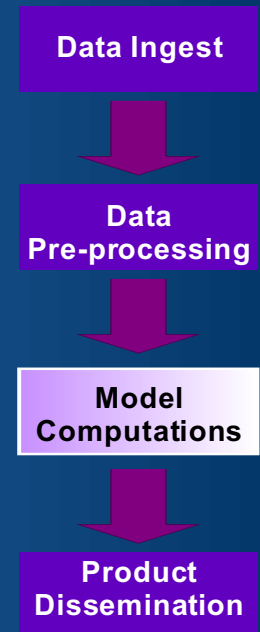
## Types of operations

- Hydrologic or hydraulic model
- Updating procedure
- Display of results (graphical or tabular)
- Time series manipulation algorithm

# Organization of Operations

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- **Segment:**
  - ▶ Group of operations performed as a unit,
  - ▶ Typically, the operations needed to do forecast computations from one point to another on a river.
- **Forecast Group:**
  - ▶ Group of segments in a computational order,
  - ▶ Typically, a tributary basin or mainstem reach.
- **Carryover Group:**
  - ▶ One or more forecast groups in a computational order,
  - ▶ Only group for which state variables can be saved,
  - ▶ Typically, one or more river basins, or the whole RFC area.



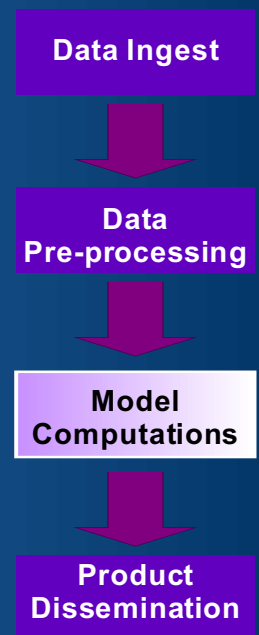


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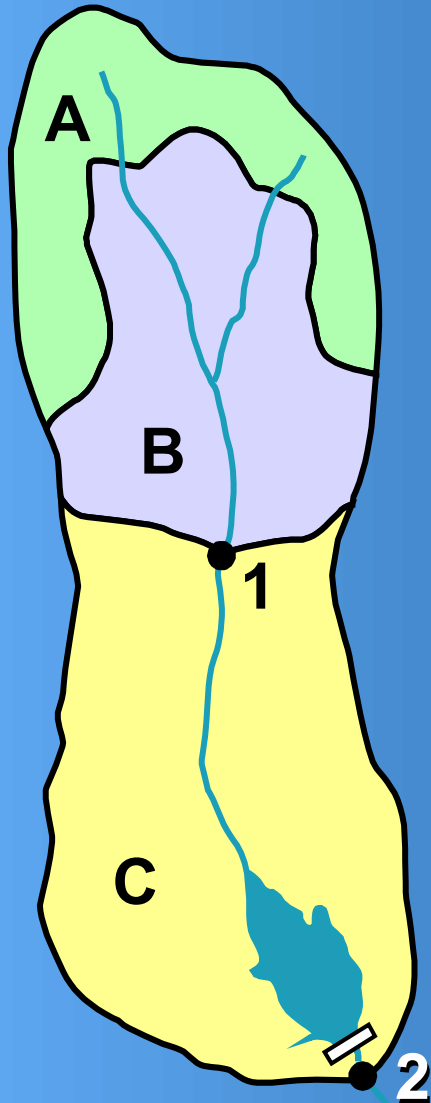
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## Operations Table

- Procedure for combining operations in the sequence needed for a particular application.
- Information is passed from one operation to next by time series.
- Advantages:
  - ▶ Any model needed can be included,
  - ▶ Easy to add new operations,
  - ▶ New methods can quickly be put into operational use, and
  - ▶ Same operations used in Calb, OFS, ESP.



# Operations Table Example



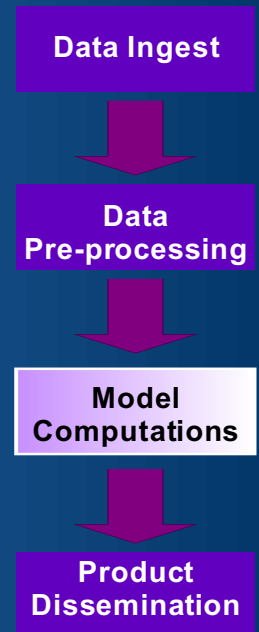
SNOW-17	Area	A
SAC-SMA	Area	A
SNOW-17	Area	B
SAC-SMA	Area	B
WEIGH-TS	Area	A + B (Runoff)
UNIT-HG	Area	A + B to Point 1
STAGE-Q	Point	1 (H -> Q)
ADJUST-Q	Point	1
STAGE-Q	Point	1 (Q -> H)
PLOT-TUL	Point	1
LAG/K	Reach 1-Reservoir	
SNOW-17	Area	C
SAC-SMA	Area	C
UNIT-HG	Area C to Reservoir	
ADD/SUB	(Routed + Local)	
MEAN-Q	(Inst -> MEAN)	
STAGE-Q	Point 2 (Tailwater -> Q)	
RES-SNGL	Reservoir/Point 2	
PLOT-TUL	(Pool/Storage)	
PLOT-TUL	(Inflow/Outflow)	

# FCINIT

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## Commands – DEF-RC

- Stage-discharge relationship
- Method of interpolation/extrapolation
  - Linear
  - Logarithmic
  - Hydraulic extension
- Forecast point information (E-19)
- Input Summary in Section V.4.2
- Free format input

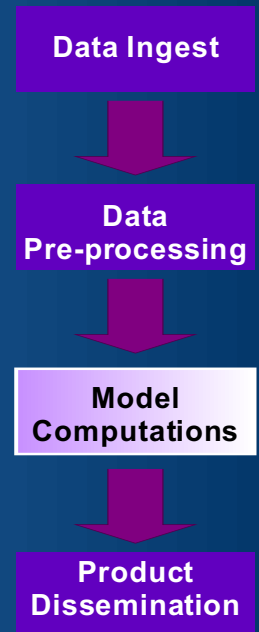


# FCINIT

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## Commands – SEGDEF/RESEGDEF

- Fixed format input
- 3 main sections
  - Identifier and location information
  - DEF-TS section
  - Operations Table
- New segments – SEGDEF
- Existing segments – RESEGDEF



# FCINIT

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## SEGDEF Section 1 - Identifier and location information

- IDENTIFIER - up to an 8 character segment identifier and latitude, longitude
- TITLE - up to a 20 character description
- UPSTREAM - up to 5 upstream segment identifiers
- DOWNSTREAM - up to 2 downstream identifiers
  - ▶ Note: IFP cannot handle 2 downstream identifiers when building its schematic. Can redefine to get hydrology order correct.

# FCINIT

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## SEGDEF Section 2 - Define Time Series information

- Must include information on each time series used in the segment
- 4 types of time series
  - Input - read from Processed Data Base (PRD)
  - Output - written to PRD
  - Update - read from and written to PRD
  - Internal - generated within segment to pass information to another operation and not stored on the PRD
- All time series need identifier, datatype code, and time step

# FCINIT

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## SEGDEF Section 2 - Define Time Series information (cont.)

- All time series stored on the PRD need second line of information (input, output, and update types)
  - ▶ External location information for where stored on PRD
  - ▶ Identifier and datatype needed for all 3 types
  - ▶ Latitude, longitude, and description needed for output and update
- Datatype used must be able to be stored on the PRD
  - ▶ prdutil command DEFTYPE to define what can be stored on PRD

# FCINIT

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## SEGDEF Section 2 - Define Time Series information (cont.)

- Valid time steps - 1, 2, 3, 4, 6, 8, 12, 24 hour
  - ▶ Time step for input time series can be a multiple of that stored on PRD (i.e. if 1 hr is stored, 6 hr can be used in segment).  
What is done at run time depends on datatype.
    - can pick off every nth value
    - can accumulate data to produce time series
  - ▶ Time step for output and update time series must match that defined in the DEF-TS section
  - ▶ Time step for internal time series must match its intended use
- Section starts with DEF-TS and ends with END



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## SEGDEF Section 3 - Operations Table

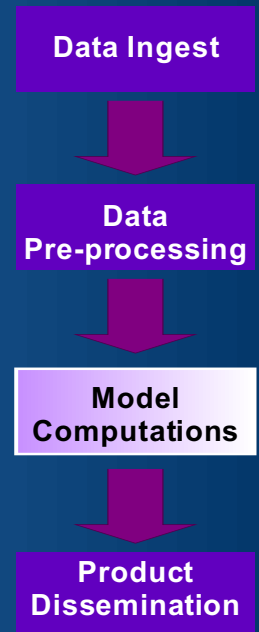
- Enter all parametric information required by operations in the proper fixed format input
  - Each operation is documented in Users Manual Section V.3.3
- Arrange operations in the order the forecaster wants them to be run

# FCINIT

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## Commands – FGDEF

- Defines normal forecast groups (FG).
- Defines computational order of segments in batch run.
  - IFP uses upstream-downstream connectivity
- All segments used must already be defined.
- Segments may not belong to another normal FG.

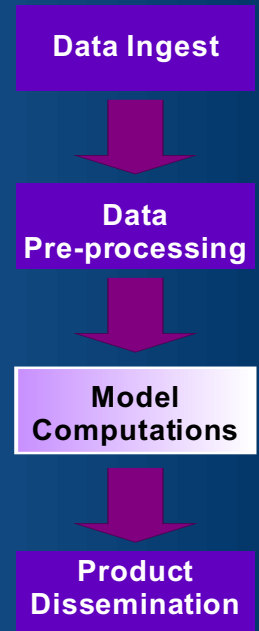


# FCINIT

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## Commands – CGDEF

- Determines computational order of FGs.
- Forecast groups must already be defined.
- Forecast group cannot belong to another CG.
- Only normal FGs.
- Must provide dates for the carryover.



# ORDER

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ppinit command

- Determines computational order of MAP, MAPX, and FMAP
- Based on order areas are used in segments in CG/FGs
- Should be run when:
  - ▶ Add new MAP, MAPX, or FMAP areas
  - ▶ Computational order is changed in a FG or CG (move segment from one FG or CG to another)

